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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/915,842	07/27/2001	Ching-Hui Ma	TS00-750	7198

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EXAMINER

CHEN, KIN CHAN

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 01/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/915,842

Applicant(s)

MA ET AL.

Examiner

Kin-Chan Chen

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-30 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. Claims 1-30 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claims 1, 15, and 24, "depositing a liner overlying said region to be contacted" is vague and indefinite. Because "region to be contacted" is considered for the intended use (in the future). Therefore, the metes and bounds of the claim are unclear when depositing a liner thereon.

In claims 2, 3, 5, 14, 16-18, 23, and 25-27, "selected from the group containing" is unclear as to the scope of the claim. It is an improper Markush language. The examiner suggests replacing it with "selected from the group consisting of".

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

3. Claims 1, 2, 4, and 10-14 are rejected under 35 U.S.C. 102(e) as being anticipated by Hung et al. (US 6,380,096 B2).

In a method of forming a damascene opening in the semiconductor device fabrication, Hung teaches that a region (such as conductive feature / metal line) is provided in or on a substrate. A liner may be deposited overlying the region. The damascene opening through the dielectric layer to the liner layer overlying the region may be etched. The first etching may comprise a high F/C ratio etch chemistry, high power, and low pressure (Figs 6-8, col. 9, lines 3-43; Table 5). The liner layer within the damascene opening may be etched. A high F/C ratio etch chemistry, low power, and low pressure may be used (col. 12, lines 29-32 and Table 7). The dielectric layer may be low k dielectric such as BCB or Black diamond (col. 13, lines 13-17), so-called a dielectric layer has a dielectric constant of less than 2.5 in the instant claims. As to dependent claims 11 and 12, power of the second etching may be 150 to 300 W (see col. 12, lines 30-34). Pressure of the second etching may be between 9 to 60 mTorr (col. 12, lines 30-34), which overlaps the claimed ranges. A barrier metal layer may be deposited within the damascene opening. A metal layer (such as copper) may be deposited overlying the barrier metal layer. The metal layer may be polished to leave the metal layer only within the damascene opening (col. 2, line 61 through col. 3, line 8; col. 9, lines 44-49). As to dependent claim 10, Hung teaches the limitation (see col. 11, Table 6).

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 3, 5, 7, 8, 15-18, 21-27, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung et al. (US 6,380,096 B2).

In a method of forming a damascene opening in the semiconductor device fabrication, Hung teaches that a region (such as conductive feature / metal line) is provided in or on a substrate. A liner may be deposited overlying the region. The damascene opening through the dielectric layer to the liner layer overlying the region may be etched. The first etching may comprise a high F/C ratio etch chemistry, high power, and low pressure (Figs 6-8, col. 9, lines 3-43; Table 5). The liner layer within the damascene opening may be etched. A high F/C ratio etch chemistry, Power of the second etching may be 150 to 300 W may be used (col. 12, lines 29-32 and Table 7). The dielectric layer may be low k dielectric such as BCB or Black diamond (col. 13, lines 13-17), so-called a dielectric layer has a dielectric constant of less than 2.5 in the instant claims. Pressure of the second etching may be between 9 to 60 mTorr (col. 12, lines 30-34), which overlaps the claimed range. A barrier metal layer may be deposited within the damascene opening. A metal layer (such as copper) may be deposited overlying the barrier metal layer. The metal layer may be polished to leave the metal layer only within

the damascene opening (col. 2, line 61 through col. 3, line 8; col. 9, lines 44-49). As to dependent claims 21 and 30, Hung teaches said etchants (see col. 11, Table 6).

Claims 3, 5, 17, 18, 26, and 27 differ from Hung by specifying thickness of liner (e.g., silicon nitride) and thickness of dielectric layer. However, it is simply a matter of choice of design depending on the specific product requirement. Hence, it would have been obvious to one with ordinary skill in the art to use different thickness of liner and dielectric in order to accommodate various features and electronic components and meet quality criteria in the semiconductor device fabrication.

The above-cited claims differ from the prior art by specifying various processing parameters (such as flow rates in claims 21 and 30; power in claims 7, 15, and 24; pressure in claims 8, 15, and 24). However, same are commonly determined by routine experiment (see Jones et al. (US 5,632,855); Nulty (US 5,562,801); Bjorkman et al. (US 6,340,435); Li (US 6,009,830); Sherman (US 4,563,367); Ionov (US 6,013,582); Silicon VLSI Technology (Plummer et al.); all in the record as evidences). Furthermore, because the skilled artisan understands that in plasma etching, changing the power changes the plasma densities and fluxes, and ion energy. Increasing the pressure causes more gas phase collisions to occur and also may increase the plasma density. The process of conducting routine optimizations so as to produce an expected result is obvious to one of ordinary skill in the art. Hence, it is the examiner's position that a person having ordinary skill in the art at the time of the claimed invention would have found it obvious to modify by performing routine experiments by using various processing parameters to obtain optimal result.

6. Claims 6, 19, and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung as applied to claims 1, 15, and 24 above, and further in view of Tang et al. (US 6,211,092).

The discussion of modified Hung from above is repeated here.

Unlike the claimed invention, Hung does not teach that first etching may comprise CF₄, O₂, and Ar. In dielectric etching (including low -k dielectric), Tang teaches that CF₄, O₂, and Ar may be used as etchant (col. 9, lines 35-46; col. 10, line 12) in order to perform highly selective etching and forming part of a complex integrated circuit structure. Hence, it would have been obvious to one with ordinary skill in the art to modify Hung by using the etchant of Tang in order to perform highly selective etching and forming part of a complex integrated circuit structure.

The above cited claims differ from the prior art by specifying different flow rates of etching gas, as stated above, same is commonly determined by routine experiment and rejected for the same reasons and evidences in the record, supra.

7. Claims 9, 20, and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hung as applied to claims 1, 15, and 24 above, and further in view of Chan et al. (US 6,312,874).

The discussion of modified Hung from above is repeated here

Unlike the claimed invention, Hung does not teach that second etching may comprise CF₄ and O₂. In dielectric etching (including low -k dielectric), Chan teaches same may be used as etchant (col.6, lines 16-52) in order to remove the bottom stop

layer (so-called liner in the instant claims) without affecting conductor by oxidation or otherwise, see col. 7, lines 42-45. Hence, it would have been obvious to one with ordinary skill in the art to modify Hung by using the etchant of Chan in order to remove the bottom stop layer (so-called liner in the instant claims) without affecting conductor by oxidation or otherwise.

The above cited claims differ from the prior art by specifying different flow rates of etching gas, as stated above, same is commonly determined by routine experiment and rejected for the same reasons and evidences in the record, *supra*.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Jones et al. (US 5,632,855) teaches a method of selectively varying uniformity of oxide etch for a semiconductor structure. A gas flow rate, gas pressure, temperature, power may be selected so as to vary the uniformity of oxide (col. 3, lines 12-32; col. 6, lines 21-23). Nulty (US 5,562,801) teaches that process parameters such as gas mixture, temperature, RF power, pressure, and gas flow rate may be varied to achieve the desired etch characteristics. (col. 1, lines 46-60). Bjorkman et al. (US 6,340,435) teaches etching rate vs. power, gas pressure(Figs). Li (US 6,009,830), col. 1, lines 33-45; Fig. 4, teaches the carrier gas (inert, helium, argon) effect on dry etching; Sherman (US 4,563,367) teaches tailoring process parameters such as gas flow rate, pressure,

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and power for dry etching using (abstract; col. Col. 5, lines 11-35). Ionov (US 6,013,582) teaches varying the ratio of etchant (concentration, composition), pressure, source power, bias power, platen temperature, time, etch rate (Tables; col. 3, lines 20-40; col. 4, lines 38-49; col. 5, lines 20-25). Silicon VLSI Technology (Plummer et al., page 639): controlling gas composition and flow rate to achieve the desired etch properties.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kin-Chan Chen whose telephone number is (703) 305-0222. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-2934.

K-C C
January 7, 2003


Patent Examiner
Group Art Unit 1765